SPRING 78
PRINTEMPS 78

The soybean variety Maple Arrow, licensed 2 years ago, will be seeded to about 800 hectares this year. See story page 31.

La variété de soya, Maple Arrow, homologuée il y a 2 ans, sera ensemencée sur 800 hectares cette année. Voir page 31.

CANADA AGRICULTURE

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Contributors may submit articles in either English or French to the Secretary, Editorial Board, Information Services, Canada Department of Agriculture, Ottawa.

La revue trimestrielle *CANADA AGRICULTURE* renseigne les vulgarisateurs et représentants du négoce agricole sur les développements de la recherche et des autres services agricoles du gouvernement fédéral.

Les articles en anglais ou en français doivent être adressés au secrétaire du Comité de rédaction, Services de l'information, ministère de l'Agriculture du Canada, Ottawa.

Agriculture Canada

PERFORMANCE OF THE NORTH COUNTRY CHEVIOT

J. A. VESELY

Ces dernières années, on a importé dans l'est du Canada un nombre appréciable de moutons North Country Cheviot alors qu'il existe dans l'Ouest depuis plusieurs dizaines d'années des troupeaux bien établis et de haut calibre. Au cours des 13 dernières années, le North Country Cheviot a été comparé à trois autres (Romnelet, Columbia, Suffolk) à la Station de recherche de Lethbridge. Les résultats de ces travaux pourraient être d'une grande utilité aux éventuels importateurs de North Country Cheviots.

North Country Cheviots at Mabou, N.S. Substantial numbers of the breed have been imported into eastern Canada in the past few years. However, testing of the breed in Alberta shows the breed's performance may not be outstanding in western Canada.

During the past few years, substantial numbers of North Country Cheviot sheep have been imported into eastern Canada. In western Canada, well-known and high quality flocks have been in production for several decades. During the past 13 years, this breed has been tested with three others — Romnelet, Columbia, and Suffolk — at the Agriculture Canada Research Station at Lethbridge. Results of this work might be useful to other potential importers of the N. C. Cheviot breed.

The overall lamb production, expressed as kilograms of lamb produced per ewe of foundation flock, is a composite trait that can be influenced significantly by the growth rate of the lambs and their survival ability, and by the fertility, prolificacy, and longevity of the ewe. All these traits were measured during the course of the experiment at Lethbridge. We can therefore present results showing that the N. C. Cheviot, under the conditions of the experiment, was not outstanding in these traits and, in some instances, was quite disappointing.

The management of this experiment could be classed as a semi-range operation. Most of the lambs were born in April or May and grazed with their mothers on the range until weaned at an average age of 108 days during the first week of August. Mature ewes grazed on the range until November 15 when they were penned for breeding. After the breeding period, they grazed again, weather permitting. During poor weather, each ewe received about 1.8 kg of alfalfa hay per day and, during the last six weeks of pregnancy, the ration was increased with 0.25 kg of barley per day. Three weeks before lambing, all ewes were vaccinated against enterotoxemia. The ewes were not herded during the grazing season as all fields were fenced with woven wire. After weaning, the ram and ewe lambs were put on a 75-day feedlot test. They were fed ad libitum a pelleted ration composed of 50% alfalfa hay, 40% barley, and 10% beet pulp.

The survival rate to marketing of N. C. Cheviot lambs was about the same as that of the suffolk lambs but was about 10% lower than that of Romnelet and Columbia.

Growth rate of the lambs was estimated on the basis of weaning weight, weight-per-day-of-age at marketing, and final weight. N. C. Cheviot was significantly lower in all three traits than each of the other breeds (Table 1).

Fertility is a trait of ewes that is expressed as number of ewes lambing per 100 ewes exposed to rams. Percentage of lambs weaned is the number of lambs weaned per 100 ewes exposed to rams. This trait is affected by prolificacy (twinning

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rate) and fertility in the ewes and survival in the lambs. The levels of these traits are somewhat low for all breeds (Table 2). However, the results in the table are weighted for age of ewe and the replacement females each year were ewe lambs. The N. C. Cheviot ewes tended to have the lowest fertility and percentage of lambs weaned. Although the percentages did not differ significantly between some of the breeds, insignificantly lower levels in several traits can accumulate to an economically important effect in the overall production trait of kilograms of lamb produced per ewe in her lifetime.

Maternal effect is another trait that is frequently mentioned in assessing performance of ewes of different breeds and is assessed from specially designed mating systems. N. C. Cheviot ewes have been often mentioned by the producers as good mothers. Our results do not support this claim, however. This trait was actually one of the most disappointing for this breed (Table 3). In general, maternal ability strongly influences weaning weights and N. C. Cheviot lambs were much lighter than those of the other breeds due to the maternal effect. This effect is also evident in traits measured after weaning, such as those of weight-per-day-of-age and final market weight. For this reason, N. C. Cheviot ewes should not be recommended for crossbreeding plans to produce two-breed cross lambs. Any merits of the N. C. Cheviot evident in crossbred ewes (two-breed or three-breed crosses) should be exploited by the use of N. C. Cheviot sires.

The so-called hardiness generally believed to be associated with the N. C. Cheviot breed apparently does not exist. Longevity of this breed was estimated to be much lower than that of the other three breeds. Ewes of the two range breeds — Romnelet and Columbia — had lower mortality rates than Suffolk ewes and Suffolk ewes had lower mortality rates than N. C. Cheviot. The mortality rates were similar in all four flocks during the first four years of their lives, but then began to increase in the N. C. Cheviot flock. This increase did not occur until after six years in the Suffolk flock.

At the end of eight and a half years of production, the percentages of foundation ewes remaining in the Romnelet, Columbia, Suffolk, and N. C. Cheviot flocks were 22, 25, 5, and 0. Survival of foundation ewes in the range flocks was zero at the end of ten and a half years. The lifetime total weight of lamb weaned per ewe is a good expression of the overall production of lamb from various breeds because it incorporates longevity. Total average weaned lamb production per ewe of foundation flocks, until all ewes in each flock had died of old age or had been removed due to culling, was 151.6 kg in Romnelet, 150.2 kg in Suffolk, 125.4 kg in Columbia, and 92.1 kg in N. C. Cheviot.

It must be recognized that the environmental, primarily climatic, conditions of western Prairies and Maritime provinces are quite different. It is possible that the environmental conditions in the Maritimes are much more suitable to the N. C. Cheviot breed and that the performance of the breed under those conditions might be improved. However, the answer to such questions cannot be given because no study on breed-environment interaction on lamb production of this breed between the two regions has been done. ■

TABLE 1. GROWTH OF LAMBS FROM FOUR BREEDS

Breed	WW (kg)	WPDA (kg)	FW (kg)
N. C. Cheviot	23.55	0.215	39.87
Romnelet	26.05	0.227	41.96
Columbia	25.37	0.224	41.45
Suffolk	27.87	0.254	46.91

TABLE 2. FERTILITY AND WEANED LAMBS (PERCENTAGES BASED ON 100 EWES EXPOSED TO RAMS)

Breed	Fertility (%)	Weaned lamb (%)
N. C. Cheviot	75	80
Romnelet	78	91
Columbia	76	84
Suffolk	83	102

TABLE 3. MATERNAL EFFECTS AS REFLECTED IN GROWTH OF LAMBS

Breed	WW (kg)	WPDA (kg)	FW (kg)
N. C. Cheviot	24.00	0.219	40.59
Romnelet	26.44	0.233	43.08
Columbia	25.99	0.232	42.92
Suffolk	26.41	0.237	43.70

QUALITY LOSS IN STORED RAPESEED

R. N. SINHA and J. T. MILLS

Les scientifiques de la Station de recherche de Winnipeg effectuent des études sur le séchage économique, à l'air naturel des greniers convenant au climat des Prairies. Des résultats préliminaires indiquent qu'il est possible de garder le centre d'un grenier à colza plus frais de 10°C grâce à ventilateur commercial bon marché.

Canada produces over a million metric tons of rapeseed a year. A quarter of this is stored in primary and terminal elevators; much of the remainder is stored on farms for varying periods. In years of moderate rainfall, rapeseed can be harvested dry and moved through the grain handling system without much spoilage. Once every 5-7 years, however, wet harvest problems are general in many areas. On these occasions, rapeseed with more than 7 to 8% moisture can spoil or heat in storage. It is then downgraded by primary elevators, or rejected by oil processors, and either sold to feed mills or discarded completely.

In a prairie-wide survey in 1974, 23% of 432 elevator managers reported spoilage and heating of rapeseed, 24% reported mite infestations. This in an indication of post-harvest quality losses in Canada's "Cinderella" crop. The processes involved are complex and the extent of loss depends on quality standards.

Ideally, high quality rapeseed has the following attributes: a sweet smell, less than 1% inseparable seeds, a moisture content below 8% by weight, more than 95% germination, more than 97% yellow seeds after crushing, no visible mold or mites, a fat acidity value below 30 mg of potassium hydroxide per 100 grams of dry seeds and a yellow colored oil.

Laboratory studies with spoiled rapeseed In the last five years laboratory and granary studies by the grain storage research group at the Winnipeg Research Station have shown that although moisture content of the seed is a crucial factor, interactions among many other factors cause post-harvest quality loss of stored rapeseed. This crop is considerably more susceptible to bin-heating and infestation by molds, bacteria and mites than barley, wheat or other cereal crops.

The beginning of spoilage in a bin of rapeseed may or may not be accompanied by heating. Spoilage is indicated by a strong aromatic smell when compared with fresh rapeseed of the same age. Farmers and the grain industry may designate low grades of rapeseed as "heated" or "heat-damaged" to denote seed that has become charred, discolored, or otherwise affected by abnormal rise in temperature in contrast to "sound rapeseed" which has a fresh smell, unaffected quality, and less than 0.2% heated seeds per sample.

Electron microscope studies show that severe heating is accompanied by breakdown of the cells that contain proteins and oil. Laboratory analysis has shown that the kinds of microflora change when the grain heats. Fungi found in fresh lots, *Alternaria* and *Cladosporium*, are gradually replaced by harmful fungi such as *Aspergillus amstelodami*, *A. repens*, and several species of *Penicillium*. The progressive increase of heat-damage is accompanied by the appearance of other kinds of fungi, including *Mucor pusillus* and *Talaromyces thermophilus*. Of these, *Aspergillus amstelodami* is the predominant storage fungus in heat-damaged seed lots. The embryo of moist rapeseed is killed when heated to 50 to 60°C. for 30 minutes. Severely heat-damaged seeds have below 2% germination, a tobacco-like odor, a low hydrogen ion concentration in deionized water, high fat acidity levels, and a high number of jet black seeds.

Field study with farm bins To determine relative storage losses between lots of rapeseed and barley, we conducted a field study in two identical circular galvanized steel bins (556 x 571 cm) with concrete floors at the Agriculture Canada experimental farm at Glenlea, Manitoba from 1973-76. Bin I contained 52 metric tons of Conquest barley at 10–12% moisture. Bin II contained 46 metric tons of Zephyr rapeseed with 8–9% moisture content. Both crops were grown and harvested at Glenlea, and placed into the bins on hot days in late August 1973. For the next three years, we took monthly samples from both bins and measured changes in temperature, moisture content, seed germination, oxygen and carbon dioxide in intergranular air, fat acidity, microflora, insects and mite infestation levels. Because of structural defects, snow and rain water entered the ventilator at the roof top and occasionally along walls of both bins and created damp pockets. Hot spots, however, occurred only in bin II containing the rapeseed. Both crops were turned once during April-May 1974.

We found that rapeseed was considerably more vulnerable to pest infestation than barley. Fat acidity, an important criteria of quality loss, did not increase in unheated barley

Dr. Sinha is an entomologist and Dr. Mills a plant pathologist both specializing in grain storage research at the Agriculture Canada Research Station, Winnipeg, Manitoba.

...quality loss

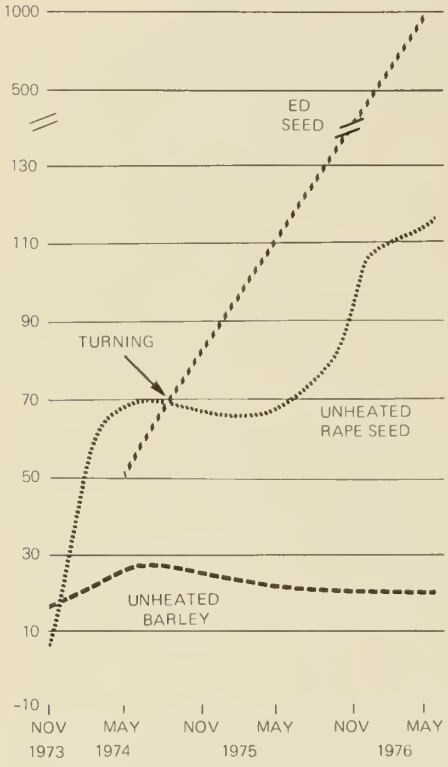


Fig. 1. Rise in fat acidity values in unheated barley and rapeseed and heated rapeseed in two farm-type storage bins at Glenlea, Manitoba during 1973-76.

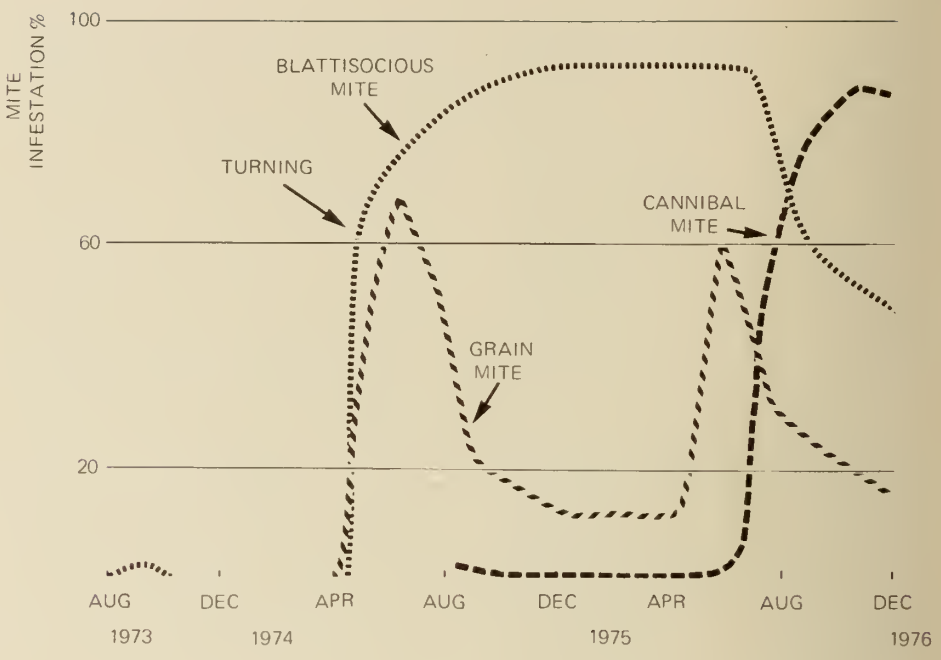


Fig. 2. Infestation levels of four kinds of mites in unheated rapeseed samples collected from a farm storage bin at Glenlea, Manitoba in 1973-76.

over three years. In rapeseed, it increased by 65% in the first year and a further 20% by the second year. A small hot spot developed along the wall of the rapeseed bin where spring rain had leaked in. The fat acidity of rapeseed from this pocket rose sharply by 50% in May 1974 and a spectacular 1000% by March 1976 (Fig. 3). The carbon dioxide level of the intergranular air in the hot spot also increased sharply indicating microbial activity that causes loss of quality.

To determine the ability of two major stored grain insects to develop infestations, 200 rusty grain beetles and 2000 red flour beetles reared in the laboratory, were introduced at the center of each bin in August 1974. None of the insects survived the winter in sufficient numbers to cause damage.

A spectacular rise in mite populations occurred shortly after the rapeseed was turned the first spring after storage (Fig. 4). The bin was heavily infested by 12 kinds of mites. The most common and abundant in rapeseed were: a grain mite, *Acarus immobilis;* the long-haired mite, *Glycyphagus destructor,* and their predators — *Blattisocius keegani* and the cannibal mite, *Cheyletus eruditus.* The barley was very lightly infested with 10 different kinds.

The blue mold, *Penicillium* and members of *Aspergillus glaucus* group were the major harmful storage fungi in rapeseed. They were scarce in samples of stored barley.

Prevention of quality loss One important reason for the international reputation of Canadian grain and oilseed crops is absence or scarcity of visible molds or insect and mite pests. Therefore, carefully planned preventive measures should be adopted to ensure freedom from these pests in Canada. The best prevention is to store rapeseed as dry as possible, ideally below the 8% moisture level. If drying is not possible in the fall, rapeseed with a high moisture content should be stored in a bin fitted with a natural air drying and aeration system. Scientists at the Winnipeg Research Station are now conducting research on low-cost, natural air, bin chilling and drying systems suitable for prairie farms. Preliminary results have shown that a farmer can keep the centre of his rapeseed bin 10°C cooler if he uses a commercial low cost aeration system. ■

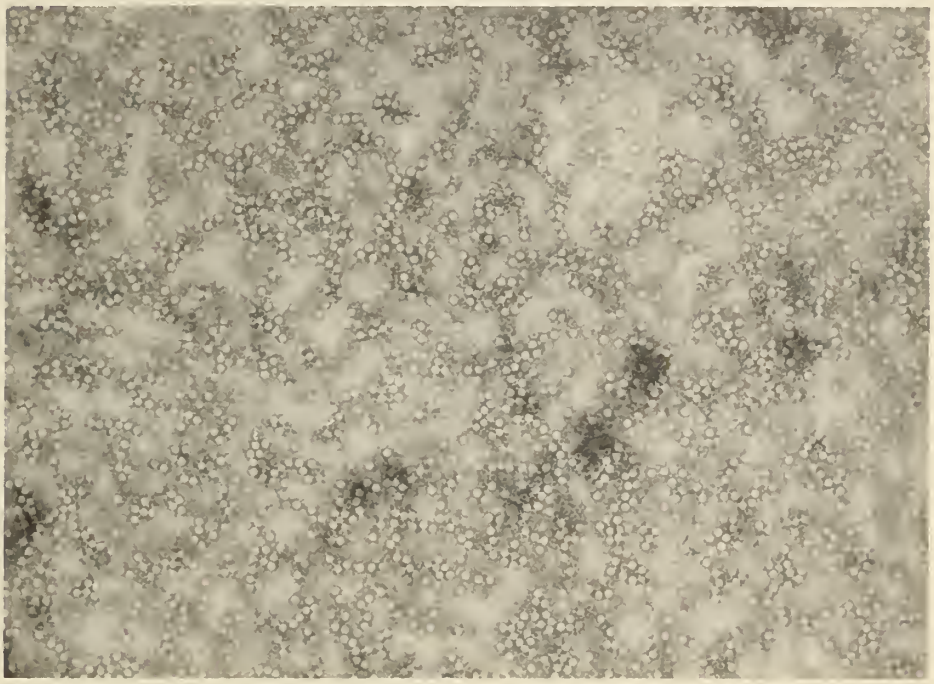
ERADICATING ALEUTIAN MINK DISEASE

HYUN J. CHO

L'élimination des sujets réagissant positivement à une contre-épreuve d'immunoélectrophorèse mise au point à Lethbridge alliée à la désinfection et au nettoyage des locaux devrait conduire à une éradication de la maladie de l'aléoutien si préjudiciable à l'économie des visonnières.

Detection and slaughter of mink with Aleutian disease (AD) could provide a basis for effective control and eradication of the disease.

Earlier research (see Canada Agriculture, Vol. 21, No. 3) resulted in a diagnostic test for the disease, considered to be one of the most devastating infectious diseases of mink causing abortion, postnatal and adult death. AD is caused by a small DNA virus and is responsible for high mortality, particularly in Aleutian genotype mink. Although death is less common in non-Aleutian mink, decreased kit production and poor pelt quality of the survivors have resulted in substantial economic losses to commercial mink ranchers throughout the world. The disease has been responsible for more ranchers to discontinue the mink business than any other.



The virus of Aleutian disease of mink (magnified 150,000X) as first isolated by Dr. Cho. This photograph was prepared by the cytology section A.D.R.I.(E) and is reproduced courtesy of Dr. A. S Greig The numerous virus particles appear to be spherical in shape with a diameter of 23 nanometers (one millionth of a millimeter). It is a single stranded DNA virus known as a parvovirus, one of the smallest viruses known. This virus was used as antigen for the detection of specific antibody present in the circulating blood of infected mink

In most infectious diseases, the body responds to infection by producing a specific antibody that binds to the causal organism and neutralizes it so that it does not affect the host. But in AD, although the infection results in the production of an antibody in the mink, the antibody combines with the disease-producing virus, resulting in antibody-virus complexes that plug up the filtering system of the kidneys. Moreover, the specific antibody does not neutralize the AD virus. In light of present scientific knowledge, this makes it impossible to produce an effective vaccine to prevent the disease.

For this reason, it was decided that to prevent AD, it must be detected early and the infected mink slaughtered. Research in co-operation with Dr. Donald Ingram, Ontario Veterinary College, resulted in a method for extracting the disease-causing virus and its antigen. Using this new antigen, an accurate and rapid diagnostic test was developed by a technique known as counter-immunoelectrophoresis (CIEP).

The antigen for this test was extracted from the tissues of infected mink. The blood serum of each mink is tested using the antigen to determine if it has been infected. Prior to this there was no accurate and practical method for detecting the disease until clinical symptoms were apparent. This usually occurs several

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TABLE 1. SUMMARY OF SEROLOGICAL TESTS FOR ALEUTIAN DISEASE IN THREE INFECTED MINK RANCHES

	Test 1974		Test 1976		Test 1977	
Ranch	Mink Tested	Reactors	Mink Tested	Reactors	Mink Tested	Reactors
1	995	849	1,527	1	1,711	1
2	1,576	592	2,004	0	2,167	0
3	1,271	51	1,259	0	987	0

months after the animal is first infected.

At A.D.R.I. (W), an extensive field trial has recently been completed to determine whether the CIEP test would provide a basis for effective control and eradication of AD from infected populations. Three infected mink ranches, one in Alberta and two in British Columbia, were selected for this study. Blood serum of all animals was tested during pelting season and before the breeding season for four consecutive years. Blood samples from the two British Columbia ranches were collected and submitted by Dr. Jeremy Greenfield, a microbiologist at the Provincial Veterinary Laboratory, Abbotsford, B.C.

In the first test, November 1974, at ranch No. 1, 849 of 995 mink in one shed reacted positively. All reactors were culled immediately. Retests of the herd in February, 1976, and again in February, 1977, revealed only a single reactor animal among 1,527 and 1,711 mink tested respectively. At ranch No. 2, the initial test of old breeding stock in November 1974 detected 592 infected animals among 1,576 animals tested. After culling the reactors, the herd was retested in February, 1976, and again in February, 1977. No infected animals were detected.

At ranch No. 3, the initial test in November 1974, showed 51 reactors out of 1,271 animals tested; but after culling, retests in November 1976, and March 1977, revealed no infected mink (Table 1).

These trials indicate that the test and slaughter procedure is practical, reliable, and relatively inexpensive for the control and eradication of AD. Because the mode of transmission of the disease is more commonly vertical in nature (passes from infected dam to her kits) than horizontal (spreads from animal to animal), the culling of reactors to the CIEP test, combined with appropriate disinfection and decontamination procedures, will result in the eradication of this economically devastating disease from individual mink ranches. ■

SNOW MOLDS OF GRASSES AND WINTER CEREALS

J. DREW SMITH

La plus grande partie des travaux réalisés dans l'identification et la répartition de la moisissure des neiges a porté sur les graminées des gazons. Les essais se poursuivent sur les graminées fourragères et gazonnantes pour déterminer leur résistance à cette maladie. Des lignées de seigle d'automne et de blé d'hiver font l'objet d'essais sélectifs dans le même but.

The terms "winter injury" and "winter kill" are often used to describe damage to grasses and winter cereals after long, cold and snowy winters. Part of the damage is due to fungal pathogens that tolerate low temperatures, that are referred to as snow molds. Losses have not been fully determined, but in some seasons they are major causes of turfgrass and winter cereal damage.

The identity and distribution of the snow mold fungi has been worked out for turf diseases because the symptoms are more obvious, but the same pathogens also affect forage grasses, winter wheat and fall rye. Forage legumes may also be damaged by some of the snow molds which attack grasses.

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Several different snow molds attack winter cereals and grasses in the colder parts of the world, sometimes singly, but also mixed together in complexes. The dominant pathogen may vary with geographical region and with seasonal differences in weather and local climate. The most important snow molds which may be found in Western Canada are *Fusarium nivale, Sclerotinia borealis, Typhula incarnata* and a low temperature-tolerant, nonsclerotial, nonspring basidiomycete, abbreviated to LTB. This is unique to some regions in western North America. A distinctly different "new" snow mold for which the name *Typhula ishikariensis* var. *canadensis* has recently been proposed is also found only in North America.

Fig. 1. Aerial photograph — *Sclerotinia borealis* snow mold (bleached, killed areas) in fall rye — Prince Albert, northern Saskatchewan, June, 1974.

Of the unidentified, low-temperature basidiomycete snow molds which have so far been investigated, the nonsclerotial LTB is probably the most common. It is known only in the mycelial state; no one so far has been able to find or induce it to produce spores. We have been unable to mate it with any of the common grass *Typhula* spp. so it probably does not belong to this genus. Since it does not seem to form sclerotia it is assumed to persist through the milder periods of the year as mycelium. It does so very successfully and is capable of causing significant damage, particularly to turfgrass in most years under quite light, moderate duration snow covers. This pathogen is also the cause of winter crown rot of forage legumes and snow mold in fall rye and winter wheat. There is a slower growing sclerotial low-temperature basidiomycete, SLTB which is widespread throughout the region, particularly on turfgrasses, but not confined to them. Isolates are capable of attacking winter cereals and in winter 1976/77 plants of timothy at Lacombe were damaged by the SLTB.

F. nivale is a ubiquitous pathogen of the winter cereals and grasses throughout the west. It is a little less tolerant of low temperatures than the others. It may make its appearance in late summer or early fall following cold rains or sleet showers, on turfgrasses in the prairie region, especially the finer golf and bowling greens. In the milder coastal regions it is capable of causing turf damage in cold wet periods at any time of the year. Damage that occurs in fall often persists until spring, becoming more extensive if deep snow covers unfrozen ground and if snow melt is protracted. When exposed to light, severely attacked leaves and plants of both grasses and cereals develop a pink color which is characteristic of the spore masses of the fungus. The snow mold may reach epidemic proportions locally in winter cereals.

S. borealis, with its comparatively large black sclerotia, is a common snow mold on fall rye, winter wheat and grasses in the heavy, long duration snowfall regions in western Canada from Manitoba to British Columbia. Although it is apparently rare in the northwestern states of the USA it has been found in Minnesota and has been associated with severe turfgrass or winter cereal disease as far south as Winnipeg, Man., Swift Current, Sask., Lacombe, Alta., and Kamloops, B.C. It caused severe damage to some rye crops in northern Saskatchewan in 1974, in some cases killing more than 50% of the plants in large fields. The inoculum may build up rapidly in successive crops of winter wheat where this crop has not previously been grown — the original source of infection probably being adjacent grasses in headlands, verges and ditches. Only completely dead, bleached plants

bear the characteristic sclerotia.

In the western and southern valleys of British Columbia *T. incarnata* may cause heavy turfgrass damage sometimes in disease complexes with *F. nivale* and the "new" *Typhula* snow mold. The latter was temporarily called "FW" since originally it was found from Fox Creek in Alberta to Wascana (Regina) in Saskatchewan. We now know from further surveys, taxonomic and genetical studies that this is a distinct variety of *T. ishikariensis* and that it is distributed from British Columbia to eastern Ontario and Minnesota. Since it is found mostly in Canada the varietal name *canadensis* has been suggested. It is highly pathogenic to winter cereals and grasses, occurs on forage legumes and may cause severe damage on grasses in years with long snowy winters like 1973/1974. *T. incarnata* usually does not need such a prolonged snow cover to cause damage.

In parallel with work on the taxonomy, distribution and host range of snow molds, research into their biology and control is being actively pursued at several research centres in western Canada. As a result of extensive field tests several new effective turf grass fungicides are available for professional use. Unfortunately, most of them are not considered suitable for domestic use.

Since the late 60's, we have been testing forage and turf grasses for resistance to snow molds at the Saskatoon Research Station using field plots artificially inoculated with cultures of snow molds. 'Dormie' bluegrass, which has high resistance to LTB, has been licensed after extensive tests by the Saskatoon and Melfort Research Stations. Several

Fig. 2. *Typhula ishikariensis* var. *canadensis* snow mold, on winter wheat and fall rye plots in the foreground and middle distance, resulting from artificial inoculation – Saskatoon, April, 1974

Fig. 3. LTB snow mold on lawn turf — University Campus, Saskatoon, May, 1973.

Fig. 4. *Typhula incarnata* snow mold — putting green in southern British Columbia, late March, 1974.

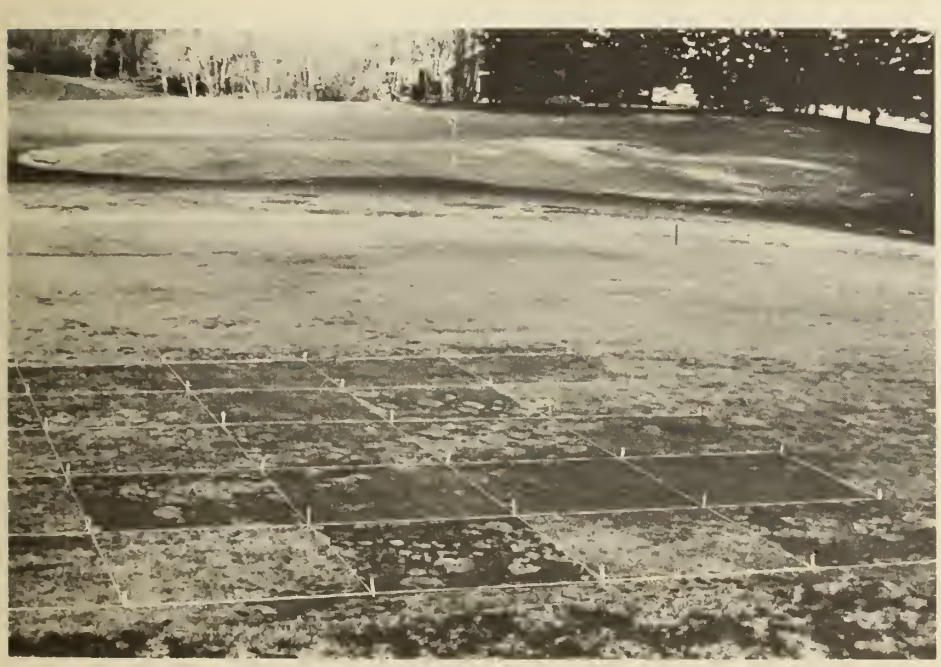


Fig. 5. Control of snow mold caused by *Typhula* FW and *S. borealis* with fungicides — Prince Albert, May, 1973.

other strains of forage and turf grasses with high snow mold resistance are well advanced in development.

At Saskatoon Research Station new techniques have been developed to screen fall rye and winter wheat lines from Canada and northern Europe for resistance to most of the common snow molds in the laboratory and growth chamber. Several of the disease-resistant fall rye lines were field tested throughout the west last winter. Fall rye varieties are being bred at Swift Current Research Station. Hardiness in winter wheat is engaging the attention of research workers at Saskatoon Crop Development Centre and Lethbridge Research Station. Winter hardiness is a more acute problem in winter wheat than in fall rye in Saskatchewan where more crops of winter wheat fail because of lack of winter hardiness than because of snow mold.

A further aspect of snow mold research is a study of antagonism between a previously undescribed low-temperature tolerant sclerotial fungus and the snow molds with which it is associated. This is a cooperative project between the Saskatoon and Beaverlodge Research Stations. Mutual antagonism between isolates of the same snow mold may play an important part in disease development. This was recently shown to be the case in the LTB and winter crown rot in alfalfa by Dr. J.B. Lebeau of the Lethbridge Research Station and independently by the writer in *Typhula* snow molds of grasses while working with Dr. K. Arsvoll in Norway. This phenomenon has also been found in other basidiomycete fungi including *Marasmius oreades* which causes fairy rings. ■

CANFARM DAIRY FEED FORMULATION SERVICE

JANET NELSON

Every week the agricultural press raises some question, or comments on feeding the dairy herd. How do you feed the dry cow? How do you use poor quality forage? Which minerals are essential and in what quantities?

Agriculture Canada, through Canfarm's Dairy Feed Formulation Service (Dairy Feed), has combined the latest dairy nutrition research with modern computer technology to provide practical up-to-date feeding recommendations.

The service is a project of Canfarm's cooperating agencies involving Canfarm's Service Agency's computer technology, provincial extension agencies and university research.

Bob Lang, a provincial dairy specialist, voiced the need for a program to balance herd rations based on available feeds and management practices on the farm to minimize feeding costs.

Dr. Bruce Stone of the University of Guelph provided research information on dairy herd nutrition. Doug McLean of Canfarm's Service Agency suggested a computer model to incorporate practical feeding recommendations from extension experience.

After two years of testing and discussion, Dairy Feed has incorporated the latest nutrient requirement recommendations based on the characteristics of an individual herd, an interactive computer network available from coast to coast and the ideas of the nutritionists and dairy cattle specialists.

Dairy Feed calculates low-cost nutritionally balanced rations for dairy cows. Separate rations are formulated for dry cows and cows at eight levels of milk production. These rations consider the size of the cow, her milk production and the average butterfat test. The rations are balanced for energy, protein, calcium, phosphorus and up to 10 other minerals and vitamins. A separate feeding guide is provided for the dry cow to match her unique nutritional needs.

Total feed intake restrictions as well as roughage requirements are taken into account. The farmer's homegrown grains and roughages can be incorporated. To supplement these feeds, the service can use commercial mixes or it can custom build mixes to utilize the farmer's own grains. It can also evaluate his current feeding program to indicate where shortages may exist.

In most provinces Dairy Feed goes hand in hand with the provincial feed analysis service. The farmer collects samples of his homegrown feeds and sends them to a feed analysis laboratory. With the help of his ag rep, agronome or dairy specialist he completes a Dairy Feed form. Standard feed information is preprinted on the input form. Developed on a regional basis, these feed sets show average nutrient composition for preferred feeds. The farmer can select feeds that he wishes to consider in balancing a ration for his herd. He may also add any other feed not included on the

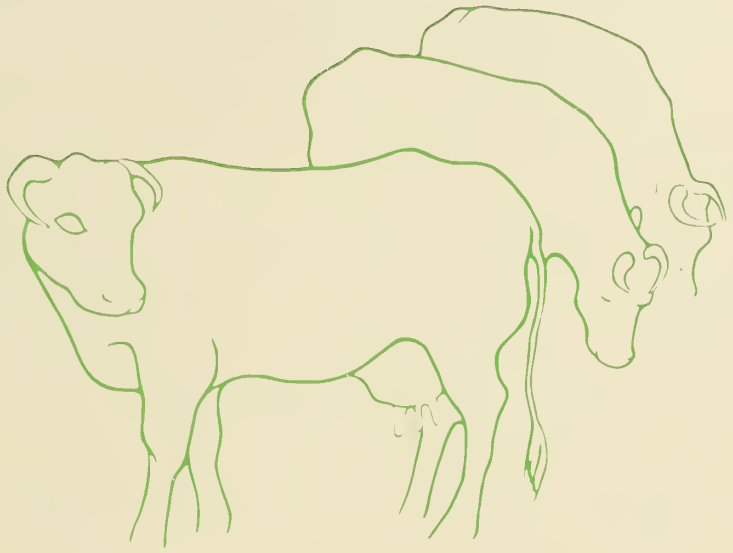
Dr. Nelson is an animal nutritionist with Canfarm in Guelph, Ont.

PROGRAMME DE LA PRÉPARATION DES RATIONS ALIMENTAIRES

JANET NELSON

Chaque semaine, on trouve dans la presse agricole des questions sur l'alimentation du troupeau laitier. Comment nourrir les vaches taries? Comment utiliser le fourrage de mauvaise qualité? Quels sont les minéraux essentiels? Quelles quantités de minéraux utiliser dans la préparation des rations?

Grâce au Service de Canfarm chargé de la préparation de rations laitières (DFFS), Agriculture Canada a pu appliquer l'informatique moderne aux traitements des résultats des dernières recherches sur la nutrition des bovins laitiers et fournir ainsi des recommandations pratiques en matière d'alimentation animale.



Ce service est un projet des organismes coopérant au sein de CANFARM comme le département d'informatique de CANFARM, les services provinciaux de vulgarisation et les organismes universitaires de recherches.

Ce fut Bob Lang, spécialiste provincial des questions laitières, qui souleva la nécessité d'avoir un programme de préparation de rations utilisant les aliments disponibles et les méthodes d'exploitation courantes, de façon à comprimer le plus possible le coût de l'alimentation.

De son côté, M. Bruce Stone, de l'Université de Guelph, fournit les données de la recherche sur la nutrition du troupeau laitier et Doug McLean, de CANFARM, proposa un modèle informatique qui incorporerait les recommandations pratiques confirmées par l'expérience touchant l'alimentation des bovins laitiers.

Après deux années d'essais et de discussions, le Service d'aide à la préparation de rations destinées à l'alimentation du troupeau laitier (DFFS) a réussi à élaborer les recommandations les plus à jour, basées à la fois sur les caractéristiques des troupeaux laitiers concernés, sur les informations obtenues par un réseau mécanographique accessible d'un bout à l'autre du pays, et sur les idées émises par les nutritionnistes et les spécialistes des questions laitières.

Le DFFS établit des rations équilibrées, à bon marché, pour la période de tarissement, ainsi que pour chacun des huit niveaux de production laitière. La préparation de ces rations est faite en fonction de la taille de la vache, de sa production laitière et de la teneur moyenne en matière grasse du lait, chaque ration étant équilibrée en regard de sa valeur énergétique et de ses teneurs en protéines, en calcium, en phosphore et en plusieurs autres minéraux et en vitamines. Un guide distinct est préparé pour les vaches taries compte tenu de leurs besoins alimentaires bien particuliers.

Sont prises en considération les restrictions relatives à l'ingestion totale et les besoins en fourrages grossiers. Les grains et les fourrages grossiers produits par l'agriculteur peuvent entrer dans la composition des rations. Le Service peut ajouter à ces aliments des mélanges commerciaux ou encore il peut établir des mélanges en utilisant les grains produits par l'agriculteur. Il peut également évaluer le programme alimentaire actuel de celui-ci et en indiquer les lacunes éventuelles.

Dans la plupart des provinces, le DFFS collabore étroitement avec les services provinciaux d'analyse des aliments. L'agriculteur recueille des échantillons des aliments qu'il a lui même produits et les envoie aux laboratoires compétents. Aidé par les agents agricoles, les agronomes ou les spécialistes des questions laitières, il remplit le formulaire fourni par le DFFS. Les informations courantes sur les aliments sont préalablement imprimées sur le formulaire.

Mme J. Nelson est nutritionniste attachée à CANFARM, à Guelph Ontario.

...feed formulation

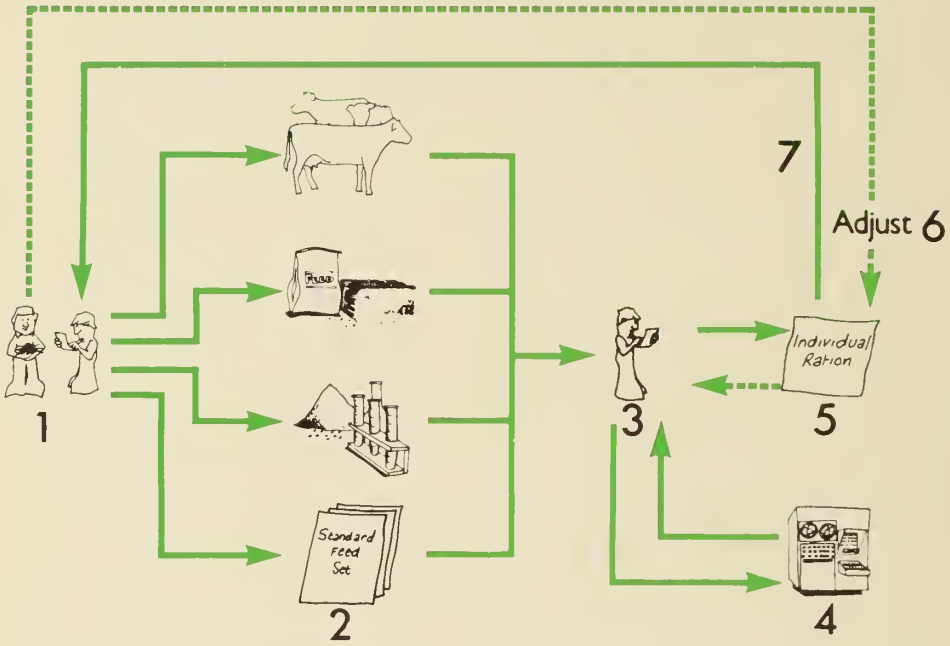


Figure 1. Delivery System for the Dairy Feed Formulation Services. The farmer and a Provincial Agricultural Representative (1) complete the input form including a description of the herd, the feeds available, the results of the feed analysis and other feeds available from the area feed set (2). A PROVINCIAL Dairy Specialist (3) enters the information into the CANFARM computer (4) and receives the report (5). He may make some adjustments (6) then return the report to the farmer (7).

form such as a particular commercial supplement. The results of the feed analysis of his homegrown feeds replace the average values preprinted on the form. In addition, the farmer must supply information about his herd, the average cow size, the average butterfat test and the expected production based on the herd's potential milk production level. The dairy specialist has the option of including modifications based on his analysis of the herd's needs, the feeds used and any nutritional problems that have occurred in the herd in the past.

Added features of the program allow the farmer to have a custom mineral and grain mix formulated, or to request that a commercial supplement be used. He can also stipulate a feed be used at a certain level to match his on-farm inventory or he may request feeds be included in a ration at a given proportion to reflect his feeding practices.

The completed form is sent to a regional or provincial office for processing. Here the dairy specialist checks the information for completeness and enters it via terminal and telephone to the CANFARM computer. The result can be printed back to him within minutes.

After examining the report, the specialist may make some adjustments before returning it to the ag rep. He in turn may assist the farmer to interpret the results by highlighting any nutritional problems which become evident during the calculation of the program or by recommending a gradual approach to any new feeding program.

The reports provide three types of information. Primarily they supply daily feeding guides for cows at eight levels of production, and the dry cow. In addition they show the composition and batch mix for a mineral and grain mix if desired. Analyses of major nutrients for requested herds are also shown.

The concepts of dairy feed formulation are simple. Good feeding practices will save money by using homegrown feeds to their greatest potential, by supplementing these feeds to match the nutritional requirements of the cows for their production potential and for good health.

The reports the farmer receives are simple and understandable. The technology which translates the concepts into the feeding guide is essentially invisible. But the success of the service for the thousands who have used it rests on the combined experience and expertise of the federal, provincial and university agencies that developed it. ■

...rations alimentaires

Conçus à l'échelle régionale, ces jeux de rations indiquent la composition moyenne en éléments nutritifs des aliments préférés. L'agriculteur peut choisir les aliments qu'il désire utiliser pour son troupeau et y ajouter tout autre aliment non mentionné sur la formule, comme par exemple les compléments préparés par l'industrie. Les résultats de l'analyse des aliments produits par l'agriculteur remplacent les valeurs moyennes déjà imprimées sur le formulaire. De plus, l'agriculteur doit indiquer la taille moyenne des vaches de son troupeau, la teneur moyenne en matière grasse du lait et la production escomptée selon le niveau possible de la production laitière de son cheptel. Le spécialiste des questions laitières a ensuite tout loisir d'y apporter des modifications d'après son appréciation des besoins du troupeau, des aliments utilisés et des troubles nutritionnels dont a pu souffrir le troupeau.

D'autres éléments du programme permettent à l'agriculteur de se faire préparer sur mesure un mélange de grains et de minéraux ou de spécifier l'utilisation d'un complément commercial. De même, il peut demander qu'un aliment particulier soit utilisé dans une certaine proportion en fonction des stocks dont il dispose ou encore du régime alimentaire qu'il a adopté pour son troupeau.

La formule remplie est envoyée au bureau régional ou provincial, où le spécialiste vérifie si les données fournies sont complètes avant de les faire entrer, par l'intermédiaire du terminal, dans l'ordinateur de CANFARM, qui lui communique les résultats sur feuille imprimante en quelques minutes.

Après avoir examiné le rapport, le spécialiste peut lui apporter quelques modifications avant de le retourner à l'agronome concerné, lequel à son tour peut aider l'agriculteur à interpréter les résultats en lui faisant voir les problèmes nutritionnels que les calculs auront pu dégager ou en recommandant une approche progressive à tout nouveau programme d'affourragement.

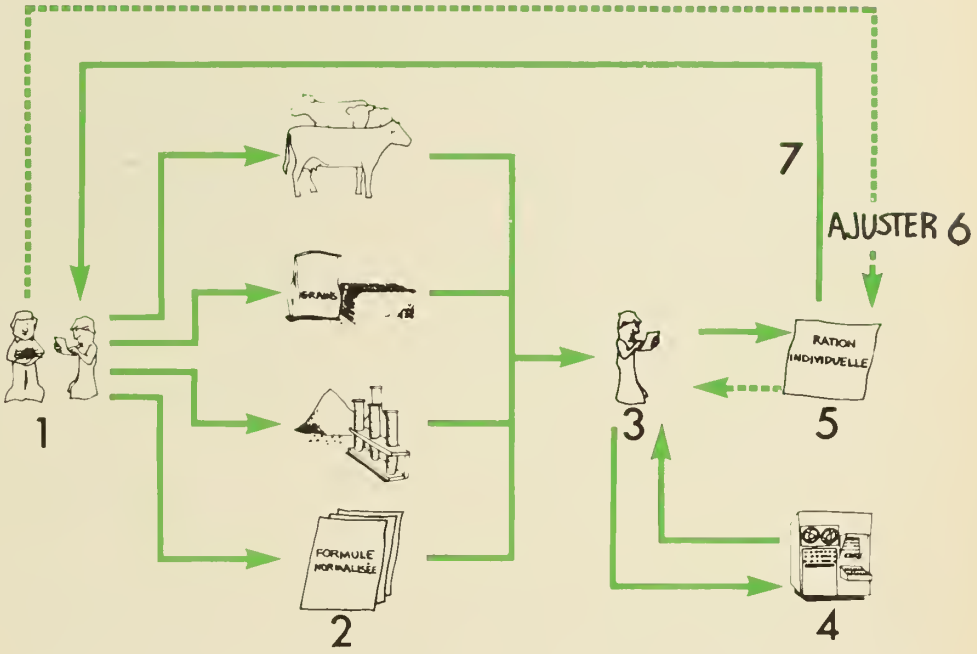


Figure 1: Système de distribution de la préparation des rations alimentaires. L'agriculteur et un représentant agricole provincial (1) complètent la formule de composition comportant une description du troupeau, l'alimentation disponible, les résultats de l'analyse des provendes et d'autres aliments disponibles à partir des rations standard régionales (2). Un spécialiste provincial du lait (3) inscrit les renseignements dans l'ordinateur CANFARM (4) et reçoit le rapport (5). Il peut faire quelques ajustements (6) et ensuite envoyer le rapport à l'agriculteur (7).

Ces rapports fournissent 3 sortes d'information. En premier lieu, ils servent de guides quotidiens pour l'alimentation des vaches à l'un ou l'autre des huit niveaux de production laitière, ou en période de tarissement. En outre, ils peuvent également montrer la composition qualitative et quantitative des mélanges de grains et de minéraux. Ils décrivent aussi sur demande les analyses des macro-nutriments dont ont besoin les troupeaux.

Les concepts à la base de la préparation de ces rations laitières sont simples. Il s'agit de réaliser des économies en exploitant au maximum les aliments produits à la ferme et en les complétant en fonction du potentiel de production et de l'hygiène des vaches.

Les rapports envoyés à l'agriculteur sont faciles à comprendre. Les techniques employées dans leur préparation ne paraissent pas mais le succès du service offert aux milliers d'agriculteurs réside dans la combinaison de l'expérience et de la technicité des organismes fédéraux, provinciaux et universitaires qui l'ont mis au point. ■

GRASSHOPPER PROGRAM

S. H. GAGE, M. K. MUKERJI
and R. H. BURRAGE

Le programme de lutte contre le criquet en Saskatchewan comprend maintenant un système de gestion tenant compte de la dynamique des populations, de la dynamique des végétaux, de l'observation biologique et de la protection des cultures. Ce système, qui assure de meilleures méthodes de gestion, fournit aux producteurs de céréales des informations sur le criquet et sur le développement des cultures, de sorte qu'ils sont en mesure de mieux choisir une méthode de protection appropriée.

Pest management has changed the emphasis on insect control. It brings together the best aspects of all control methods in an ecologically sound manner. The concept implies suppression of insect populations rather than an insect-free environment.

The expanded grasshopper program in Saskatchewan includes a management system aimed at integrating population dynamics, plant dynamics, biological monitoring and crop protection. The system is being developed as separate modules and tested to provide grain growers of Saskatchewan, through their agricultural representatives, with current information on grasshopper and crop development so that options regarding crop protection can be adequately assessed. Figure 1 shows the modules in the system in schematic fashion. More research may be needed to clarify some of the parameters within the models; also, new methods of crop protection can be added to the system.

The Agrometeorology Section of the Chemical and Biological Research Institute, Ottawa, has been providing the daily weather information (temperature, precipitation, and soil moisture for three soil textures in both stubble and fallow fields) from 36 weather stations in the three Prairie Provinces. Daily data are updated weekly on computer files. Specific variables — heat units (bases 0°, 5° and 10° C) accumulated daily and daily soil moisture (%) — are created for grasshopper and crop development computer models.

The adult grasshopper survey provides essential information on population density and distribution of four major species. The survey is generally conducted in August but must be timed to use the grasshopper development model in different districts during the peak of the adult stage. Information from the adult survey is used to forecast the grasshopper potential for the following crop year so that preparations for protection can be made if necessary.

The grasshopper egg survey, conducted during early October, helps confirm the density levels measured during the adult survey and provides information on embryonic development. Eggs are collected from 38 sites throughout the crop-growing area to determine the developmental state and density of egg populations of the four major species. Egg collections are examined for development and parasites. The developmental information is used to determine the distribution of embryonic development for the model.

The grasshopper development model uses daily weather data as well as information on the distribution and development of egg populations befire freeze-up. Embryonic development is further monitored through the model from April 1 the following year until hatch. After hatch, nymphal development is monitored by using the model through each of the five successive instars until the peak adult emergence.

Damage caused by grasshoppers is closely related to the state of crop growth and the response of host plants when grasshoppers are feeding. Therefore, crop growth must be interfaced with the development of

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grasshoppers. This interaction and the grasshopper population level determine the degree of damage caused by grasshoppers and also identify where and what level of crop protection is needed. Areas with severe grasshopper damage are often characterized by irregular defoliation along the field margins. The damage development model predicts where damage survey should be conducted.

The damage survey is conducted at optimal time (at the peak of the third instar), and the areas selected for the survey depend on the actual and estimated crop protection efforts. Aerial photographs of cropland, using infra-red film, are analyzed for grasshopper damage. Equations have been developed that correlate color density readings from photographs to biomass and subsequently to crop yield per unit area. To estimate economic loss, the crop production and crop protection costs and yield price should be assessed for both damaged and undamaged areas.

In late fall, a grasshopper population forecast is made based on adult survey information. This is a preliminary estimate of the population potential in the following year.

Several factors can change the potential. Adults may not lay their potential number of eggs if weather during the egg-laying period is cool. Also, eggs may not develop to the maximum before diapause if temperatures are low or soil moisture is below a specific threshold. Mortality in the egg stage may be high depending on the weather in the fall, winter and following spring; so the population will be lower than predicted.

Conversely, the potential may be significantly increased if weather is favorable for grasshoppers. Then the grasshopper damage potential is dynamic because the same level of grasshoppers can cause different degrees of damage, depending on the rate of crop growth during the earlier part of the growing season and on the rate of grasshopper development at that time. For this reason the damage potential must be examined periodically during the growing season using real-time weather in addition to crop and grasshopper development.

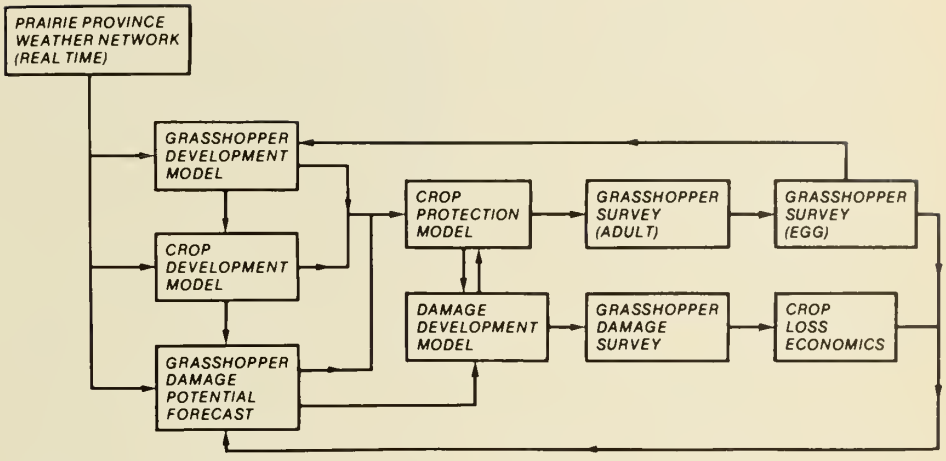

Figure 1. Grasshopper management system

From 1978 on, reports and maps will be produced weekly to show the distribution and progression of embryonic and nymphal development from April 1 to the peak adult stage. The distribution of embryonic development for the following generation will also be shown by maps after September 30. Maps will be produced showing the distribution of crop growth and grasshopper damage potential at weekly intervals from May to August. At the appropriate time, suggestions will be made to maximize crop protection based on the occurrence of third-instar nymphs and grasshopper damage potential. The report produced from the crop protection model will include additional considerations such as pesticide type and amount, where to apply it and number of applications. Other options will be suggested where applicable, including cultural operations such as trapping and baiting. Separate recommendations will be made for individual districts or group of districts depending on the distribution of grasshopper development and damage potential.

The progress of defoliation in selected fields will be monitored by field staff to validate the predictions of damage generated by the models. This information will be used to optimize timing for remote sensing of grasshopper damage. These reports and maps will be distributed to the agricultural representatives throughout the province so they can disseminate the necessary information to the growers. ■

RUTABAGA FOLIAR SPRAYS

UMESH C. GUPTA and
J. A. CUTCLIFFE

L'épandage de bore incorporé aux engrais habituels n'est pas un moyen toujours efficace de lutte contre le coeur brun des rutabagas dans l'île-du-Prince-Édouard. La carence suspectée en bore peut maintenant être contrôlée par une application foliaire au cours de la période de croissance.

Deficiency of boron (B) in rutabaga causes a condition known as brown-heart, a soft watery core in the center of the root. Roots severely deficient in B often show a crack in the middle of the brown watery core area and have a rough and netted surface. Such roots lose dry matter and have a reduced sugar content. Roots affected with brown-heart are unmarketable and since those slightly affected do not necessarily show exterior symptoms, the entire crop can fail to meet Canada grade standards. Thus, producers frequently suffert heavy financial loss where only a small percentage of rutabaga plants are deficient in B.

While B deficiency in rutabaga occurs most frequently in fields where B has not been applied; brown-heart sometimes occurs in crops fertilized with mixtures containing B. This may be due to improper mixing of B in the bulk N-P-K fertilizer, to uneven application, or to insufficient quantity of B in the mixed fertilizer.

Foliar application of molybdenum (Mo) has been used successfully on forage crops and cauliflower in P.E.I. But no information was available on the behavior of B uptake by rutabaga leaf tissue in the Maritime provinces. So a study was undertaken to determine the effectiveness of foliar application on brown-heart at four locations over a period of two years.

The data show that roots from treatments with no applied B had severe brown-heart (Table 1). The B deficiency in rutabaga was completely controlled by two 1.12 kg B/ha applications two weeks apart. Foliar sprays resulted in leaf tissue B concentrations of 60 to 120 ppm. Foliar sprays of B applied at 4 weeks after seeding resulted in higher leaf tissue B concentrations than those applied at a later stage of growth.

Rutabaga roots show signs of brown heart and cracking because of B deficiency

TABLE 1 EFFECT OF FOLIAR APPLICATIONS OF B ON B CONCENTRATION OF RUTABAGA LEAVES GROWN IN PRINCE EDWARD ISLAND.

Location number and (year)	B treatments		
	0	2.24[+]	2.24[++]
	ppm B, in leaf tissue		
1 (1974)	25*	77	68
2 (1974)	19*	64	57
3 (1976)	28*	121	82
4 (1976)	27*	100	58

*Roots with severe brown-heart.
[+]1.12 kg B/ha applied 4 weeks after seeding and 2 weeks later.
[++]1.12 kg B/ha applied when roots began to swell and 2 weeks later.

Dr. Gupta is a specialist in micronutrients in soils and plants and Mr. Cutcliffe is Head, Horticulture Section, Agriculture Canada Research Station, Charlottetown, Prince Edward Island

In general, rutabaga roots are free of brown-heart if the B concentration in their leaf tissue is greater than 40 ppm.

In conclusion, it can be stated that foliar sprays are an effective method of controlling brown-heart in Prince Edward Island. They give uniform distribution, and can be used to advantage as the only application, or where a deficiency is suspected because the mixed fertilizer containing B may not have been applied uniformly. B is applied as two foliar sprays each at the rate of 1.12 kg B/ha during the growing season. Early sprays result in greater absorption than those applied when the roots have started to swell. ■

APPLE GROWERS HAVE REPLANT PROBLEMS

R. G. ROSS

Les pomiculteurs de Nouvelle-Écosse et ailleurs dans le monde, obtiennent une faible croissance lorsque les arbres des vergers sont transplantés à cause de la maladie dite de la replantation. Des expériences montrent les réponses qu'on peut attendre de la fumigation du sol à l'aide de la chloropicrine.

In Nova Scotia, apple growers have difficulty obtaining satisfactory growth of trees when replanting orchards. A problem called specific replant disease is suspected. The disease has been found in many countries and occurs despite good care, and irrespective of the length of time between removal of the trees and replanting.

Dr. Ross is Head, Plant Pathology and Pesticide Residue Section, Agriculture Canada Research Station, Kentville, Nova Scotia.

...replant problems

Replant diseases occur mainly in apples, cherries and peaches. Pears and plums do not appear to be particularly susceptible. Invariably, replant diseases occur only on fruit crops following the same or closely related crops. When apples follow apples and possibly when apples follow pears a replant problem may arise but not when apples follow peaches and cherries or vice versa. Their specificity is an important characteristic of replant diseases.

Severity varies in different orchards and planting sites and, while its presence may be obvious when it is severe, it may escape notice when mild, because, apart from poor growth there are no clear-cut symptoms or external signs of the disease. The disease causes poor shoot growth, accompanied or caused by an unhealthy root system which consists of short, thin and sparsely branched roots. Leaves and shoots appear healthy so the disease may not be suspected unless a comparison of growth can be made with that of healthy trees of the same age.

The replant disease is very persistent in the soil and cannot be avoided by short rest periods during which unrelated crops are grown. Orchards planted nine years after removing the original trees have done poorly because of replant disease and it is not known whether it persists indefinitely or not. The disease is most harmful to the trees the first year after planting. After this they grow more normally but will always lag behind healthy trees. Fortunately the disease is largely immobile in the soil and there is no danger of contaminating nearby land. It also does not stay with the tree because trees stunted by replant recover quickly when moved to fresh soil.

The cause is unknown despite extensive investigation throughout the world. Specific replant disease of cherry and plum is now thought to be caused by a fungus in the soil so perhaps the causal agent of apple replant will be discovered soon. Nematodes were once considered to be responsible but are now known not to be the cause. Of course nematodes can cause poor growth but not that due to replant. Such things as nutrition, toxic substances secreted by roots of old trees, arsenic levels and soil sickness have been investigated without finding a causal agent.

A simple and fairly effective control is to resoil the planting site. About a ton of soil has to be replaced at each site, so it is not very practical. Fortunately, it had been discovered elsewhere that specific apple replant disease can be overcome by fumigating the soil with chloropicrin before replanting. This technique has been tried in Nova Scotia.

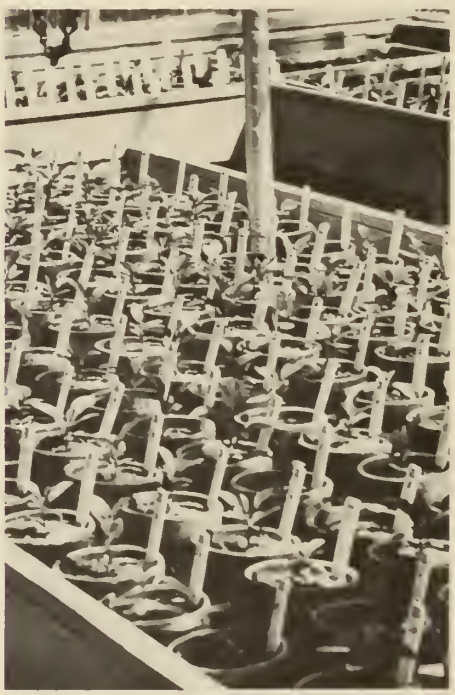

Figure 1. Greenhouse test for replant disease of apple.

The test, developed in Europe, consisted of growing a Beautiful Arcade apple seedling in the greenhouse in each of 10 pots of soil collected from an orchard and in each of 10 pots of the same soil fumigated with chloropicrin. The growth of the seedlings was measured at frequent intervals and if at the end of the growing period the seedlings in the fumigated soil had grown significantly better than those In non-fumigated soil, the orchard was considered to have a replant problem.

In 1970, two soil samples from each of five apple orchards were tested. One sample was taken from an orchard site where young apple trees were growing poorly and the other was from a site where growth was considered satisfactory. The growth of the seedlings was significantly increased by fumigation in the poor growth soils from three of the five orchards. Fumigation increased growth in only one of the five soils from good growth areas. It would probably be concluded that the poor performance of the apple trees in three of the five orchards was due to a replant problem. Further pot bioassay tests in 1971 and 1972 gave similar results and supplied additional evidence that a replant problem exists in Nova Scotia apple orchards which might be controlled with chloropicrin.

An orchard in Woodville, Nova Scotia, had been planted to McIntosh apple trees on Beautiful Arcade rootstock in 1968 and variation in growth suggested a replant prob-

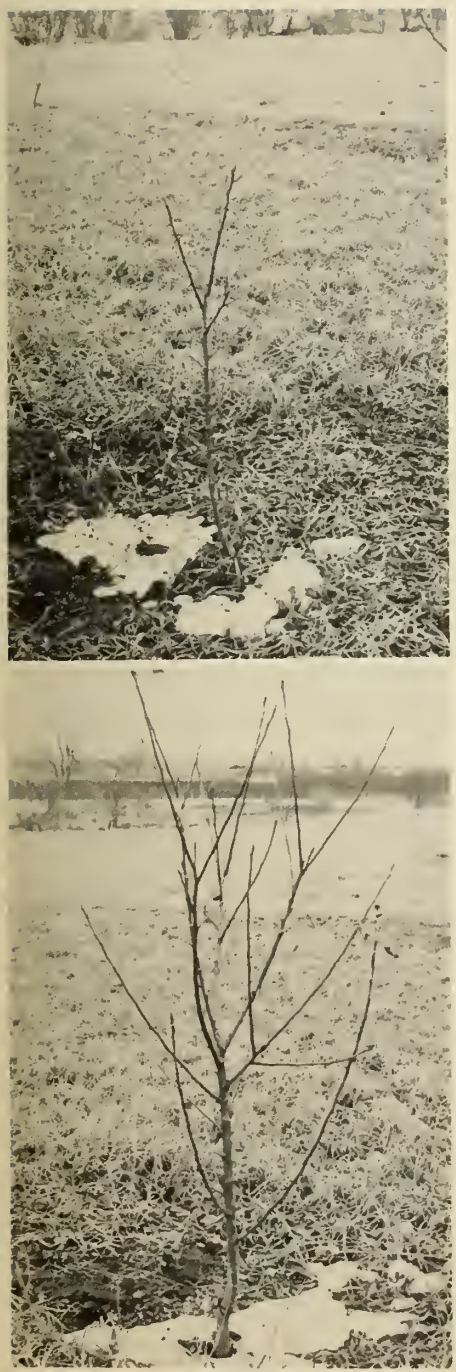

Figure 2. Apple seedlings in non-fumigated (above) and chloropicrin fumigated (below) orchard soil.

Figure 3. Spy apple trees one year after planting in a non-fumigated site (left) and chloropicrin fumigated site (right).

lem. The following gives data on the size of the trees in 1973 and on a pot test on soil from under the trees.

Other soil factors were also investigated but the evidence suggests that the variation in growth was due to a replant problem. Tree sites 27, 30 and 36 were definitely in a replant area but it is not known if the area of sites 12 and 20 had been in orchard.

In this same orchard, a test on the effect of field fumigation on

Tree	Trunk cross section (cm^2)	Length of BA Seedlings in pots (cm)	
		Fumigated	Non-fumigated
12	67	47	17
20	70	45	24
27	35	43	8
30	24	52	4
36	29	57	15

growth was done in a row adjacent to trees 30 and 36 on 13 tree sites, 2.7 m apart. In October, 1974, every other tree site was fumigated with chloropicrin. The land was first cultivated to a fine tilth to a depth of about 23 cm and an area 137 cm x 137 cm was fumigated by injecting with a hand injector, at a depth of 15 cm, 1.5 ml chloropicrin per 22.9 cm^2, totalling 54 ml per tree site. After fumigation the soil was sealed by tramping. In May, 1975, uniform maiden whips of Northern Spy on Malling 7A rootstock were planted in each of the 13 sites and measurements were taken on their growth in the fall. There was a marked response to fumigation in some tree sites, while in others the trees grew as well in non-fumigated as in fumigated soil. This suggests that the response to fumigation was obtained in the tree sites of the original orchard. Despite the variation between sites the average shoot growth was 259 cm in the fumigated sites and 162 cm in the nonfumigated sites.

Another test at the Research Station involved a paired observation trial of 10 apple strains and cultivars on Beautiful Arcade rootstocks. A pot test had shown that this orchard had a replant problem. Twenty planting sites, 2.7 m apart, were laid out in a single row and divided into 10 pairs. One site of each pair was fumigated with chloropicrin on May 5, 1974 and on June 5 maiden

whips of the 10 strains and cultivars were planted in pairs. The average shoot growth (cm) was as follows:

	1st year	2nd year
Fumigated	121	1037
Nonfumigated	63	757

Here again there was a good response in tree growth to field fumigation. Most selections responded in the first year but in two the response did not occur until the second year after planting.

These experiments illustrate the responses that might be expected by fumigating with chloropicrin. Chloropicrin is somewhat difficult to use so some field trials have been done with the fumigant Vorlex. They indicate that it will be useful in overcoming our replant problems. There is still a lot we do not know about the apple replant problem. However, the greenhouse pot test shows whether or not the problem is present and fumigating the planting site of replant disease soils gives a good start to the young tree. Whether or not a new orchard becomes economically productive may depend on the start it gets. There is little that can be done to cure a replant problem once the tree is in the ground so we must ensure that it gets the best start possible. ■

MULCHES PROTECT PEPPERS FROM VIRUSES

W. G. KEMP

Les cultures de légumes en rangs très espacés et sarclées à nu qui se projettent en silhouette sur le sol, fournissent des conditions idéales de prolifération des pucerons vecteurs de la mosaïque. Des expériences suggèrent que des paillis de chaume ou de sciure de bois sont un moyen de lutte dans le cas des piments verts et peut-être d'autres cultures maraîchères.

The standard practice of growing vegetables in widely spaced, clean cultivated rows, strikingly silhouetted against bare brown soil provides ideal conditions for aphid colonization and favors the spread of non-persistent mosaic viruses transmitted by them. Plantings of pepper in Ontario are hard hit periodically by a complex of such viruses; cucumber mosaic virus predominates, but potato virus Y, tobacco etch virus and alfalfa mosaic virus also have been isolated. Despite repeated applications of both contact and systemic insecticides, chemical control measures directed at the vectors of these stylet-borne viruses of pepper were rarely successful in earlier, small-plot experiments at the Research Station, Agriculture Canada, Vineland Station, Ontario.

As part of a research project aimed at developing integrated control measures for virus diseases of vegetable crops, we disrupted the pattern of green pepper plants contrasted against brown soil. It was hoped that this would make the crop less attractive to aphids and, thereby decrease virus incidence. The crop background was changed simply by mulching with various crop residues. These mulches not only conserve soil and water and stabilize oil temperature but also change the micro-climate immediately above the mulched soils, the background color surrounding a crop, and the

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nutrition of the plants. Each of these factors either alone or in combination could influence aphid population and virus infection in some vegetable crops.

Results of two year's work with straw, sawdust, woodchips and corncob mulches although preliminary, are promising.

In 1975 and again in 1976 these four organic mulches were established in plots of the same unit area, the same rectangularity, and on the same sites. Plants were spaced 45 cm apart in rows and 90 cm apart between rows providing a density of 11,960 plants per hectare. Each mulch was represented by 3 plots arranged in a randomized block.

The cultivar Keystone was transplanted to the plots during the first week in June in both years. The plots were irrigated immediately after transplanting, and later as required. Bare soil plots were kept weed-free by using herbicides and hoeing. The occasional weed found in mulched plots was pulled by hand. All plots were left unprotected against disease and insect damage and data were collected weekly on virus disease incidence. Aphid counts were also made weekly on 25 leaves from each plot. Yellow-pan water traps positioned 75 cm above the ground in each plot were used to assess the activity of winged aphids throughout the season.

Our results demonstrate that aphid behavior was modified over straw, sawdust, woodchip and corncob mulches and virus incidence was reduced. Catches of alate (winged) aphids (mostly *Myzus persicae)* during the period June through September in both years showed that consistently more aphids were caught above the bare soil plots than over the mulched plots. By the end of July, 1976, 38 percent of the total number of aphids caught in water traps were over bare soil whereas only 17, 18, 16, and 11 percent of the total were trapped over sawdust, woodchips, corncobs and straw, respectively. By late September catches over the bare soil and the same mulches were 34, 18, 20, 17, and 11 percent of the total.

Experimental field plots used to compare the effect of organic mulches on both the activity of winged aphids and on virus disease incidence in a pepper crop. Plot in foreground is mulched with corn-cobs and contains a yellow-pan water trap positioned 75 cm above ground.

The experiments also showed that the various mulch backgrounds decreased aphid populations on the pepper plants. It was not clear, however, whether the lower populations were due to differential attraction of the alate to peppers by these mulches or to differential development of aphid colonies on plants in mulched plots. In 1975 consistently more aphids were present on leaves of plants surrounded by bare soil than on those mulched with the various crop residues. On 29 September, 1975, 46 percent of the total aphids recorded on leaves were from plants grown with a bare soil background. In contrast 5, 32, 7, and 10 percent of the total aphids counted on the leaves were from the plots mulched with sawdust, woodchip, corncob, and straw, respectively.

Coincident with the decrease in migrating aphid populations over the organic mulches and in aphid numbers colonizing the leaves of plants in these mulched plots was a considerable decrease in virus

incidence. Relative to plants in bare soil plots, the incidence of aphid-transmitted viruses in the cultivar Keystone in 1975 was reduced by all the mulches at season's end. Straw, the most effective mulch, reduced the virus incidence by 60 percent. Virus incidence was reduced by 45 percent with sawdust, by 35 percent with woodchip, and by only 12 percent with corncob mulches. Virus incidence was lowest on plots mulched with straw and sawdust where aphid populations were also lowest. Straw and sawdust also delayed the onset of the logarithmic phase of the disease epidemic. Rate of spread in plots mulched with these crop residues and in bare soil plots, however, was unaffected.

In 1976, the virus incidence was not reduced by the organic mulches at season's end as it was in 1975. On 1 August, however, the effect of mulches was evident; virus incidence was reduced by 75 percent with sawdust, 72 percent with straw, 63 percent with corncobs, and 53 percent with woodchips. Again, there was a delay of the onset of the log phase of the disease by 2-3 weeks.

Present results suggest that straw and sawdust mulches offer the grower a practical method of reducing aphid populations and virus incidence in peppers and perhaps other vegetable crops. Apparently the beneficial effect results from breaking the pattern of green plants contrasted against bare brown soil. More research is needed before we can fully exploit this possibility or reveal the limitations of manipulating crop background. Nevertheless mulching should be considered as a possible component of any integrated control program for aphids and those viruses transmitted by them. ■

TIMBER MILKVETCH TOXICITY

W. MAJAK

L'astragale (*Astragalus serotinus*) renferme un poison qui ravage le bétail de certains pâturages de la Colombie-Britannique et de l'Alberta. Des chercheurs mettent actuellement au point un train de lignes directrices basées sur des déterminations cumulatives de la lumière mesurée à l'aide de photomètres chimiques. Ces lignes directrices indiqueront aux exploitants de parcours les époques et les lieux où ces plantes présentent la plus forte toxicité et leur permettront d'établir le calendrier de paissance de façon à réduire les risques d'exposition dans les zones dangereuses.

Dr. Majak is a plant biochemist with the CDA Range Research Station at Kamloops, B.C.

Miserotoxin (3-nitro-1-propyl-B-D-glucopyranoside) is the poisonous principle in timber milkvetch (*Astragalus miser* var. *serotinus*) that affects rangeland cattle. The perennial native legume is found throughout south-central British Columbia, and northern Washington and is distributed extensively in the British Columbia interior from elevations of 750 m to 1,680 m on various slopes, exposures and soil types.

These physical features encompass two important plant zones of practical significance: the rough fescue (*Festuca scrabrella*) grasslands, and the Douglas fir (*Pseudotsuga menziesii*) forests accounting for 2.5 and 15.5 million acres respectively. A large part of this area is used by holders of grazing leases and permits for approximately one-quarter million head of cattle. Each year 2 to 5% of the rangeland cattle are either chronically or fatally affected by timber milkvetch (TMV). The economic losses are magnified by reduced weight gains, calf crop

losses and forced shipment of cattle.

Poisoned animals exhibit weakness, emaciation, abnormal gait characterized by clicking heels, respiratory distress, muscular incoordination and finally, cardiac failure.

In British Columbia, ecology and economics prohibit a general chemical control of TMV with herbicides. Approximately 86% of the rangeland is under tree cover and these forests serve the dual purpose of cattle and wildlife domain.

Alternatively, reliable methods of predicting TMV toxicity under various rangeland conditions and subsequent controlled cattle movement could serve to prevent livestock losses. A set of guidelines should be developed for the range manager to tell him when and where the plant is most toxic. Grazing schedules minimizing exposure to hazardous zones could be planned accordingly.

It was demonstrated initially that significant variations in the TMV concentration of miserotoxin do occur. The results of a survey conducted during 1973 at 19 representative rangeland sites in British Columbia indicate that the highest miserotoxin levels are in the rough fescue grasslands during the spring. Concomitantly, the medium-canopied Douglas fir forest reveal significantly lower levels, while exposed

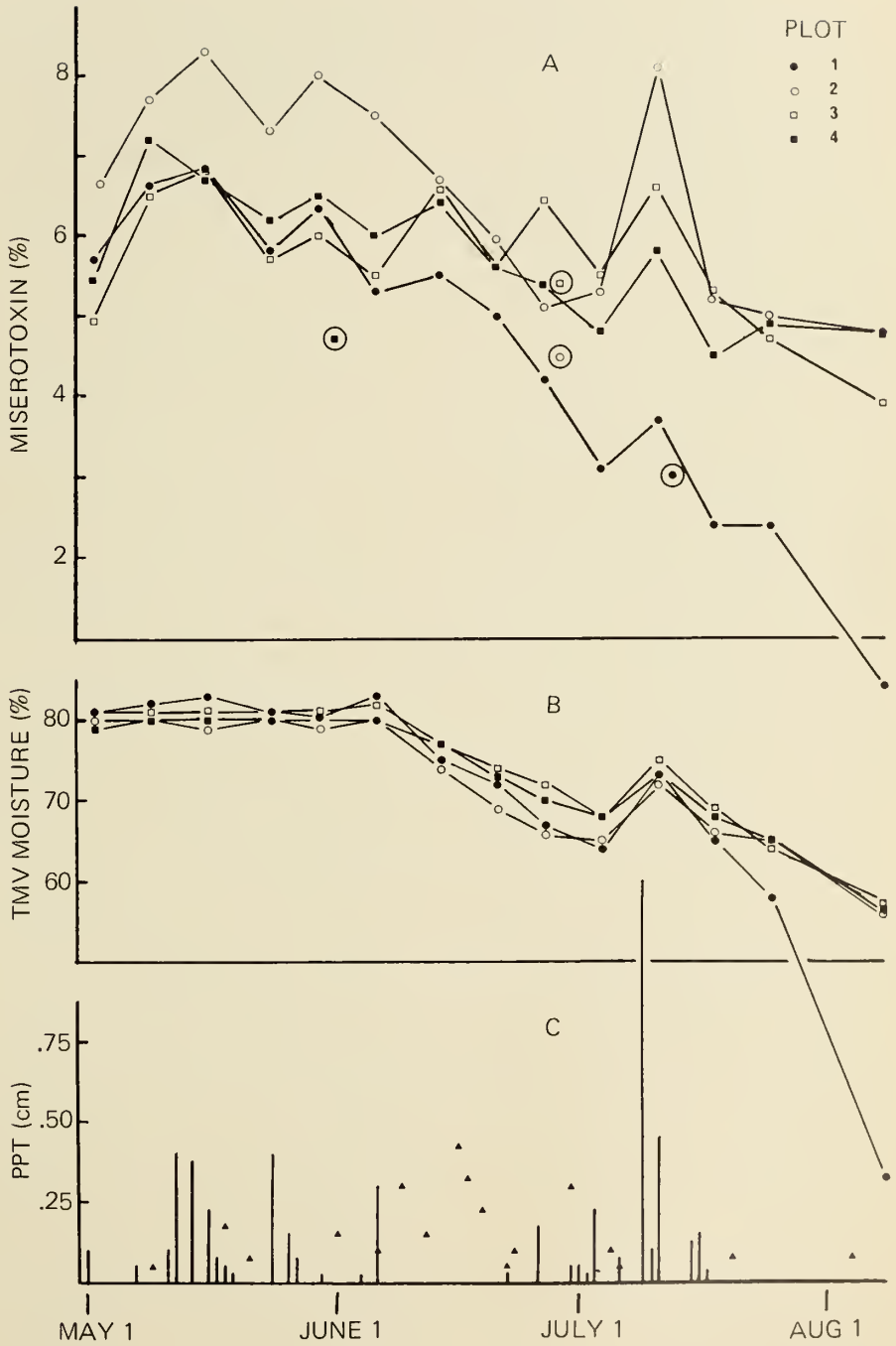

Figure (A) Weekly variation in miserotoxin concentration (per cent dry weight) of timber milkvetch on grassland plots in 1974 with terminal values for 1973 circled. (B) Corresponding changes in moisture content of timber milkvetch collected in 1974. (C) Daily precipitation (PPT) for the Kamloops area during spring and summer of 1974 (bar graph) and 1973 (triangles).

...TMV toxicity

forest areas such as ponderosa pine (*Pinus ponderosa*) savannahs and lodgepole pine (*Pinus contorta*) stands with a recent history of fire show intermediate toxin value.

Peak miserotoxin values are usually associated with prebud and bud stages of growth followed by a decline during the flower-to-pod interval. A relationship is apparent between available light and TMV toxicity; but physical features such as elevation, slope, exposure and latitude do not correlate with miserotoxin concentration. The data suggest that cattle poisoning from TMV can be reduced, by not grazing specific areas with extensive TMV infestations and by avoiding grazing on rough fescue grasslands during spring and on exposed forests of the Douglas fir zone during summer.

Sequential TMV sampling was intensified during 1974 in an effort to monitor sudden increases in toxicity and to observe interseasonal differences in toxicity patterns. In addition, daily climatological reports from strategically located weather stations indicated that rainfall patterns were related to changes in miserotoxin levels. On rough fescue grasslands, for example, the substantial increase in rainfall during the April-to-August period of 1974, not only extended toxicity intervals but also increased TMV toxin levels (see Figure). The most spectacular response to moisture occurred on the grasslands during a large storm that deposited heavy rain throughout the study area. Moisture content of TMV samples collected immediately after the storm had increased by 6 to 9% coinciding with a 16 to 34% increase in miserotoxin concentration (see Figure). This resurgence in TMV toxicity points to an induced synthesis of miserotoxin in response to favorable moisture conditions. It appears that heavy rainfall activates miserotoxin biosynthetic pathways.

Livestock poisoning resulting from TMV ingestion has often been associated with grazing in lodgepole pine stands. Pure lodgepole pine stands encompass approximately 50% of the timbered rangeland in B.C. A knowledge of the variation in TMV toxicity in these fire succession communities was required to further develop methods for predicting hazardous zones. The interval between 1973 and 1976 was characterized by two weather extremes during the summer grazing periods: exceptional drought in 1973 and record-breaking rainfalls in 1976. The large-scale, slow-moving upper trough (19 days of precipitation amounting to 12.24 cm of rain) of August, 1976, produced a dramatic and prolonged increase in miserotoxin levels at lodgepole pine sites compared to the declines in miserotoxin concentration characteristic of the drier years, 1973 to 1975. Thus, rainfall patterns were featured again in the toxicity profile of TMV.

Variations in miserotoxin levels in lodgepole pine stands and Douglas fir stands were assessed in relation to understory light regimes to test the suggested relationship between available light and TMV toxicity. Cumulative light at each experimental site was measured with chemical light meters using a "full-sun" (FS) plot as a 100% benchmark. When the lodgepole pine sites were grouped as less than 15% FS, 15-35% FS, and more than 35% FS, increased TMV toxicity was revealed. However, in spite of significant differences in light regimes at Douglas fir plots, these sites continued to show the lowest miserotoxin levels.

The practical significance of these observations is that with the information available the producer can discriminate between high and low-toxin areas and predict sudden increases in TMV toxicity.

The management steps he can take are:

1. Defer spring grazing on fescue grasslands, especially where TMV is abundant;
2. Avoid summer grazing on open lodgepole pine forests infested with TMV;
3. Recognize the potential for greatly increased toxicity of TMV under conditions of ample soil moisture. ■

BIOLOGICAL CONTROL OF LEAFMINERS

R. J. McCLANAHAN

Les résultats d'un programme de lutte contre la mineuse des légumes cultivés en serre justifient la poursuite des expériences sur des parasites et des essais sur *Diglyphus* ont été faits dans une serre commerciale. Si l'on peut arriver à une méthode appropriée, elle sera incorporée au programme actuel de lutte biologique contre l'aleurode des serres par *Encarsia formosa*.

Line drawing of *Opius dimidiatus*, a parasite most abundant outdoors, tested to control vegetable leafminer.

Line drawing of *Diglyphus begini*, a parasite used to control vegetable leafminer in Florida and Texas.

There are many species of leafminers, small insects that form tunnels between the upper and lower surfaces of leaves. The adult stage may be a moth, a fly or a wasp-like insect. The vegetable leafminer, *Liriomyza sativae* Blanchard, is a fly that has caused considerable damage in southern Ontario to greenhouse crops of tomatoes, cucumbers and chrysanthemums. It is a major pest on many outdoor crops in the southern United States.

A project is underway at the Harrow Research Station to find a means of controlling the vegetable leafminer in greenhouse crops. The main emphasis of the research is on biological control. If a successful program can be achieved, it will fit in with the present biological control of whiteflies by the parasite *Encarsia formosa*. This program was described in the summer issue of Canada Agriculture in 1973.

In general leafminers are quite susceptible to control by parasites. The larvae, sandwiched between the epidermal cells in a leaf, are limited to the tunnel they have eaten out, and they cannot escape parasites by moving or dropping away. Parasites locate the mines by tapping their antennae over the leaf surface, and they lay their eggs in the leafminer larva of nearby in the tunnel.

The vegetable leafminer and other related species in the southern United States are attacked by various kinds of parasitic wasps. There is some uncertainty about the exact association of host and parasite in certain cases because of the difficulty in identifying leafminer adults to species, and the obvious problem that a parasite destroys its particular host. It still seems that about 20 species of parasite will attack the vegetable leafminer. Many of these are general feeders and develop in other kinds of leafminers.

Leafminers are present on clover, alfalfa, cole crops, cucumber and many weeds such as goldenrod and columbine in southern Ontario. The parasite complex associated with these various species was unknown. An experiment was initiated in 1975 to "trap" leafminer parasites through the summer. Bean plants were placed in a cage of vegetable leafminers for eight hours so that numerous eggs were laid in the leaves. The plants were held for three days to allow larval mines to develop. Then they were placed outside at five different sites for a three-day period, and after that they were kept in the laboratory for emergence of leafminers and parasites. This was repeated weekly. There was a surprising number of parasites "trapped" in this manner. Ten species were recovered. Most of them were from all sites, and collectively they were in the field from late April to September. Some were known as general parasites of leafminers, others provided new records of host-parasite associations.

The experiment was repeated in 1976, and the total number of parasites collected was higher. The number of each species indicated their abundance can change from one year to another. This method did not indicate the native host leafminers, but the extent and diversity of native parasites probably explains why leafminers are not a serious problem in the field.

Unscreened ventitalors and open doors of greenhouses in the summer make it possible for parasites to enter and start attacking the vegetable leafminer on tomato and chrysanthemum crops. Periodic collections of leaves with leafmines from greenhouses in the Leamington, Ont., area provided proof that this sometimes occurs. Seven of the

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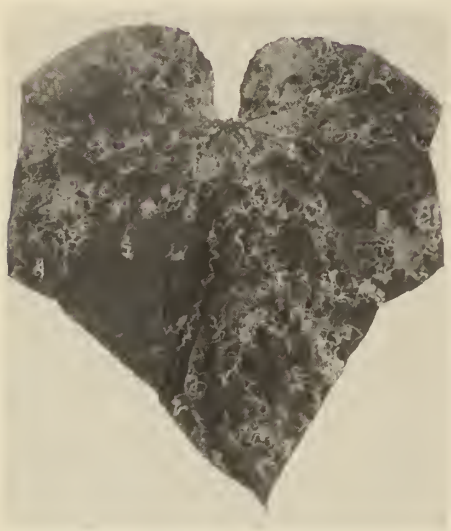

Cucumber leaf damaged by vegetable leafminer.

parasite species found outdoors were also present in the greenhouse, but only two were plentiful. Many greenhouses with high numbers of leafminers had no parasites present. A greenhouse pest management program could include the early introduction of one or more parasite species to combat the vegetable leafminer.

The special conditions of temperature, humidity and cultural operations in the greenhouse might not be suitable for some of the native parasites. Small greenhouse sections were used to study the suitability of the various parasite species for biological control of leafminers. The first to be tested was *Opius dimidiatus*, the species most abundant outdoors. Eight tomato plants were infested with vegetable leafminer, and two lots of 32 parasites were released a week apart. This parasite species maintained itself but the numbers did not become high enough to control the leafminer.

A second parasite, *Diglyphus begini*, was tested the same way. This species, while not abundant here, helps to control vegetable leafminers in Florida and Texas. After a period of leafminer abundance, when they averaged 36 adults per plant, the parasite became effective. Leafminer adults averaged only three per plant a month later, and parasite adults were present. Thus this species seems to be more suitable for greenhouse use.

These promising results justify more experiments with other parasite species and trials of *Diglyphus begini* in a commercial greenhouse. Other species of leafminers are pests in greenhouses in Europe, but this program of pest management using leafminer parasites could be useful there too. Greenhouse growers are very much in favor of alternatives to chemical control programs whenever possible. ■

REMOTE SENSING — A NEW TOOL FOR THE FARMER

SALLY ARMSTRONG and GEORGE CLASSEN

Le satellite Landsat placé en orbite par la NASA survole le Canada trois fois par jour, en suivant trois trajectoires différentes; il transporte un système de détection multispectral à balayage qui recueille des images de la surface terrestre dans quatre bandes du spectre du visible et de l'infra-rouge. Les données enregistrées au-dessus du Canada sont transmises à une des deux stations réceptrices où elles sont placées sur des rubans magnétiques expédiés par la suite au Centre canadien de télédétection. Ces données mises à la disposition de l'administration publique et du secteur privé, comportent de nombreux usages agricoles.

Ms. Armstrong and Mr. Classen are information officers with Energy, Mines and Resources.

Remote sensing is rapidly being incorporated into Canadian agriculture to make farming more efficient and planning more rational.

Satellite and airborne data, or both, are being used in many projects:

- to estimate winter kill in alfalfa (Quebec);
- to monitor overgrazing on rangeland (Alberta and British Columbia);
- to sense soil moisture and soil salinity;

- census of livestock in buildings near streams (southern Ontario);
- to estimate blueberry acreage (New Brunswick);
- native-pasture assessment (Rocky Mountains and Alberta);
- crop assessment to improve practices and pinpoint problems in fields;
- measure green harvested grain acreage for forage (Alberta);
- grassland mapping (Saskatchewan); and
- spread of urbanization onto crop land.

Canada's remote-sensing system is being spearheaded by the Canada Centre for Remote Sensing (CCRS), Department of Energy, Mines and Resources; in co-operation with Agriculture, and Transport Canada, and provincial resource agencies.

The principle of remote sensing is based on spectrography. When sunlight falls on a leaf, some of the energy is absorbed and some is reflected. The human eye can detect only part of this reflected light on energy. The ultraviolet and infrared wavelengths not detected by the human eye are picked up by various airborne or orbital cameras. These scanners often yield more information than the visible wavelengths. Vegetation reflects light in different wavelengths so that a specific wavelength pattern becomes the "signature" of a particular crop under one set of conditions. An example is a mature and healthy corn crop.

Crops vary in maturity and disease incidence. Such changes in crop conditions can be picked up by remote sensing. For example, diseased wheat has a lower near-infrared reflectance than healthy wheat. Remote sensing in the infrared band may detect crop diseases before they become apparent to observers on the ground. In some cases, acreage affected by disease may be assessed more accurately by remote sensing than by ground observation.

Two aerial photos taken one year apart of the same alfalfa field. Stress due to winter injury is shown by the mottled appearance of the canopy (left). Recovery the following year is shown by the few remaining void areas (right).

The Landsat satellite placed in orbit by NASA (U.S. National Aeronautics and Space Administration) passes over Canada three times per day in widely separated orbits. Complete coverage is achieved every 18 days. The satellite carries a multispectral scanner (MSS) system that collects imagery from the earth's surface simultaneously in four spectral bands, both in the visible and in the infrared ranges of the spectrum.

Data collected over Canada are transmitted to one of two satellite-receiving stations in this country and transferred to magnetic tapes. The tapes are forwarded to CCRS in Ottawa where the imagery, after processing, is made available to government and private users.

Photo-like images from satellite data can be produced in color or black and white and used for visual analysis of surface features. Analysis can be carried out automatically by means of a simple electro-optical system or by a more sophisticated system such as the CCRS Image Analysis System (CIAS). CIAS analyzes data in terms of pixels, a name given to the smallest discrete picture elements which, in the case of Landsat, represent approximately 0.5 hectares on the ground. Once CIAS has been "taught" to recognize the spectral signature of some feature, it can identify all other areas with the same reflectance and, other things equal, the same feature.

An area of 10,000 square miles

can be displayed on the CIAS television screen; for closer inspection, the analyst can enlarge the image so that only 400 square miles, or less, are displayed.

The output of the system takes the shape of thematic maps showing classified areas or of hard-copy photographic prints of the image on the screen. For example, by using CIAS, land-use maps for all of Prince Edward Island were produced in four hours.

As interpreters become familiar with spectral characteristics and their variations, a potentially important use of satellite data is emerging: crop-acreage inventories.

Using the CIAS, researchers classify data obtained over cereal-growing regions such as the Prairies In cultivated areas the density of the crop is assessed, pixel by pixel, either with CIAS or a second CCRS analysis system.

The proportion of pixels representing a dense vegetative condition in relation to the total vegetated area is a reliable indicator of the potential harvest — barring post-inspection bad weather, or disease. The method increases in value if the data are complemented with meteorological information.

Emerging from this type of research is the Crop Information Program being developed by Agriculture Canada's Soil Research Institute. Using Landsat imagery, the system will estimate expected grain and oilseed production — an important tool in planning international marketing strategies. Dr. A. R. Mack of Agriculture Canada heads the project. He believes that initial aspects of the system could become operational in 1978 for spring wheat and in 1979 for winter wheat, on a "trouble-shooting" basis.

A study to estimate potato acreage in New Brunswick is of considerable regional importance. Almost 50% of the province's farming income is derived from the potato harvest, and having accurate acreage and yield estimates on which to base a marketing price would be of help to farmers.

In co-operation with CCRS, Dr. Peter Mosher, New Brunswick Department of Agriculture and Rural Development, has been experimenting with both aerial and Landsat data to make harvest estimates and to identify other crops in the potato belt.

Surveys were done in test areas from aircraft at altitudes of 15,000 and 30,000 feet, and data from the satellite orbiting at an altitude of 565 miles. It was found that airborne sensing appears to be the best method for identifying small fields of crops in the potato belt. Landsat data show potential for measuring potato acreage and estimating yield, though confusion occurs in identifying potato varieties and other crops.

Landsat data have also been used by agriculturalists in Prince Edward Island who found the cost of regular surveys by aircraft to be prohibitive. Norbert Stewart, soil physicist with the P.E.I. Department of Agriculture and Forestry, explains that the island has a serious erosion problem. By analyzing Landsat data, Dr. Robert Ryerson, an environmental scientist at CCRS, has identified areas of bare ground after harvest. Coupling that information with ground data, areas of hilly, bare ground were identified. The planting of fall-seeded grains in these areas will go a long way to control spring erosion.

Another project is underway in southwestern Ontario to estimate white and red kidney-bean acreages. Experiments at two test areas were conducted for the Ontario Bean Producers Marketing Board. To date, estimates of bean acreages in the two test areas of 20 square miles vary in accuracy between 85 and 96%. The Marketing Board requires estimates that are 90% accurate 95% of the time.

By visual analysis of false-color imagery, acreage estimates ranging in accuracy from 85 to 96% could be achieved. Accuracies were higher when Landsat data were used (between 91 and 96%) because there was less confusion between bean and other crops, such as alfalfa, corn, grains and wheat.

Satellite sensing will never replace all traditional methods of information-gathering, but it will supplement earth-bound views in important and effective ways.

Traditional information-gathering methods by ground surveys are not always adequate or rapid enough for obtaining a complete up-to-date picture of farming in Canada. Dr. Mosher, while agreeing that personal communication with farmers seems a more down-to-earth way of obtaining information, says that such a method often produces nearly as many acreage estimates as there are farmers. In any case, time does not allow it. Satellites collect data from an area the size of New Brunswick in less time than it takes to plant a row of potatoes.

There are still shortcomings in the satellite applications. One of these is the weather: Landsat imagery can be obtained only if the area of interest is not overcast. The problem is particularly severe for researchers interested in such short-lived phenomena as specific stages of crop growth.

A solution may be found in the

new microwave (radar) sensor, capable of collecting data in all kinds of weather. This type of sensor will be carried by the SEASAT satellite to be launched by NASA in 1978.

Another process that requires further work is automated analysis. The full range of information capable of being extracted from satellite imagery is not yet accessible via existing analytical techniques.

Remote sensing in many forms clearly promises to be a valuable tool to Canada's farmers and those charged with marketing farm production, especially cereals, at home and abroad. Furthermore, through its research at the Canada Centre for Remote Sensing, in federal and provincial agencies, and in private organizations, this country is spearheading new approaches to information gathering and food-supply planning that will benefit other nations throughout the world, especially in the less developed regions. ■

ECHOES
FROM THE FIELD AND LAB

ECHOS
DES LABOS ET D'AILLEURS

MAPLE ARROW The soybean variety Maple Arrow, licensed two years ago, will be seeded to about 800 hectares this year, says Dr. Harvey Voldeng, who helped develop the variety.

In 1977, about 40 acres were planted with pedigreed Maple Arrow seed. One grower in eastern Ontario harvested 59 bushels per acre.

Besides having a higher yield and oil content, Maple Arrow matures early enough to be grown in eastern Ontario, Quebec and Nova Scotia's Annapolis Valley, Dr. Voldeng says. The new variety is also doing well in central Ontario around London, just outside the soybean belt.

The growing season for Maple Arrow is 125 to 130 days. Dr. Josef Seitzer, another Ottawa Research Station plant breeder, is currently working on a variety that will have a growing season of 95 to 100 days. This would enable the crop to be grown in southern Manitoba and some areas of Alberta, he says.

RAPESEED IN WEST GERMANY Tower, a Canadian rapeseed variety, has been registered in West Germany after two years of official testing. Plant breeder Hans Ulrich Hege, acting as the local representative, has been given the rights under the Variety Protection Law. Tower was found to blossom and ripen early, be free of erucic acid and have a low glucosinolate content.

PRAIRIELAND SOLVES SHORTCOMING The most serious problem of Altai wild ryegrass, a forage crop tested since 1950, has been its low seed yield. Now, seed yields have been increased three-fold, from 85 to 250 kg/ha, for the newly licensed variety, Prairieland.

Researchers M.R. Kilcher and T. Lawrence of CDA's Swift Current, Sask., Research Station, say Altai wild ryegrass has wide adaptation to all conditions, but also has excellent potential to extend the grazing season into the winter months, to reclaim saline areas and to make use of areas with a high water table.

Among the forage crop's merits are longevity, hardiness, earliness of growth, palatability, high curing quality, excellent root penetration, good yielding ability, firm, stiff leaves for winter grazing, good salinity tolerance and tolerance to deep seeding.

Seed of Prairieland is being increased under the Canadian Forage Seeds Project

BLACKLEG THREATENS A new virulent strain of Blackleg is seriously threatening rapeseed in northeastern Saskatchewan, says Dr. G.A. Petrie of CDA's Saskatoon Research Station. The infestation has so far apparently been limited to a few badly infected fields and scattered outbreaks. The disease is being closely watched since it has seriously limited rapeseed production in Australia and Europe. The disease can live for two to three years on stubble, but eventually dies out if no rapeseed is planted. However, airborne spores can transport the disease from field to field.

Blackleg can be eradicated from seed through treatment available in a formulation with other chemicals to control flea-beetles as well. Further information will be available from ag reps.

CANADA COMMITTEE ON AGROMETEOROLOGY CDA's Research Branch has published the theme papers of a meeting of the Canada Committee on Agrometeorology in February, 1977. The theme was Climatic Variability in Relation to Agricultural Productivity and Practices.

Several recommendations are made: for example, that the Atmospheric Environment Service be informed of agriculture's interest in climatic research; that the environmental requirements of Canada's major crops be assessed; that more detailed surveys be used to classify soil moisture regimes; and that the interdisciplinary efforts of federal, provincial and university agencies in studying the impact of climatic variability on agricultural production be accelerated

The papers have already been distributed to federal and provincial government departments, to universities and to interested research establishments. They are available to agricultural extension workers or other interested parties from Agrometeorology Research and Service, Research Branch, Agriculture Canada, Ottawa K1A 0C6.

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